

EXPLOSIVES

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In 2002, U.S. explosives production was 2.51 million metric tons (Mt), 6% higher than that in 2001; sales of explosives were reported in all States except Delaware. Coal mining, with 68% of total consumption, continued to be the dominant use for explosives in the United States. West Virginia, Kentucky, Wyoming, Indiana, Virginia, and Pennsylvania, in descending order, were the largest consuming States, with a combined total of 58% of U.S. sales.

Legislation and Government Programs

The Safe Explosives Act was signed into law by the President on November 25, 2002. The Act adds three new categories of persons prohibited from receiving or possessing explosives—aliens (with limited exceptions), persons who have been dishonorably discharged from the military, and citizens of the United States who have renounced their citizenship. When requested by the newly reorganized and renamed Bureau of Alcohol, Tobacco, Firearms and Explosives (ATF), manufacturers and importers of explosive materials, including ammonium nitrate, must submit samples of these materials to the ATF, as well as information on their chemical composition or other information. This will assist the ATF in the identification of explosives found at crime scenes. These changes became effective on January 24, 2003, and additional provisions for intrastate permits, enhanced background checks, and license inspections became effective on May 24, 2003 (U.S. Department of Justice, Bureau of Alcohol, Tobacco and Firearms, 2002b§¹).

Also on November 25, the President signed the Homeland Security Act of 2002 into law, which created a new Cabinet-level agency by consolidating a number of existing agencies and devoting them to making America safer and more secure. Although the original Bureau of Alcohol, Tobacco and Firearms was not included as a part of that new agency, part of the legislation provided for a split of the original U.S. Department of the Treasury agency into two separate bureaus. By January 24, 2003, one part of the existing Bureau was established in the U.S. Department of Justice as the ATF to oversee firearms, explosives, and arson programs and to deal with the Federal criminal laws concerning alcohol and tobacco smuggling and diversion. On the same day, a corresponding entity within the U.S. Department of the Treasury known as the Tax and Trade Bureau was created to handle the regulatory and taxation aspects of the alcohol and tobacco industries (U.S. Department of Justice, Bureau of Alcohol, Tobacco, Firearms and Explosives, 2002a§). For the remainder of this report, ATF will indicate the U.S. Department of the Treasury's Bureau of Alcohol, Tobacco and Firearms.

Production

Sales of ammonium-nitrate-based explosives (blasting agents and oxidizers) were 2.47 Mt, which was a 6% increase from those of 2001, and accounted for 98% of U.S. industrial explosives sales. Sales of permissibles declined by 17%, and sales of other high explosives increased by 11% (table 1). Figure 1 shows how sales for consumption have changed since 1993. Data for 2002 are not exactly comparable to data in 2001 because one company, Nelson Brothers LLC, had not provided data to the Institute of Makers of Explosives (IME) in 2001, and no estimate for its sales was included in the totals. Nelson Brothers provided data in 2002.

Companies contributing data to this report, including those that are not members of the IME, are as follows:

Accurate Energetic Systems LLC
Advanced Initiation Systems Inc.
Agrium Inc.*²
Apache Nitrogen Products Inc.*
Austin Powder Co.
Baker Atlas International
Coastal Chemical Inc.*
D.C. Guelich Explosives Co.
Douglas Explosives Inc.
Dyno Nobel Inc.
El Dorado Chemical Co.*
Ensign-Bickford Co., The
Explosives Technologies International Inc. (ETI)
General Dynamics Armament Systems
Jet Research Center
Mining Services International Corp.

¹References that include a section mark (§) are found in the Internet References Cited section.

²Companies denoted by an asterisk are not members of the IME.

Nelson Brothers LLC*
Nitram Inc.*
Nitrochem LLC
Orica USA Inc.
Owen Oil Tools Inc.
PCS Nitrogen Corp.*
St. Lawrence Explosives Corp.
Schlumberger Perforating Center
Senex Explosives Inc.
Slurry Explosives Corp.
Titan Completion Products Ltd.
Vet's Explosives Inc.
Viking Explosives and Supply Co.
W.A. Murphy Inc.

The ATF seized Slurry Explosives Corp.'s (a subsidiary of LSB Industries Inc.) Hallowell, KS, plant on January 29 after an inspection determined that the company was storing nearly 50 times the amount of explosives allowed under its license. The license allowed the company to store 90,000 pounds of explosives, but the ATF removed 4.2 million pounds. The ATF removed 161 truckloads of blasting agents, blasting caps, high explosives, military cannon powder, and military illumination candles. Much of the stockpile was outdated materials acquired from the U.S. military for recycling in the company's product, which was marketed primarily to the mining and demolition industries. The ATF revoked the company's license and began a Federal criminal investigation of the company (McKinney, 2002§). After receiving permission from the ATF to reopen and having its license returned, Slurry Explosives, operating as Universal Tech Corp. (also a subsidiary of LSB Industries) began manufacturing explosives again in October.

In December, Energetic Additives Inc. (a 50%-owned subsidiary of American Pacific Corp., a Las Vegas, NV, specialty chemicals manufacturer) invested \$10.7 million in Los Gatos, CA-based Energetic Systems Inc. (a joint-venture entity formed to acquire and manage a commercial explosives business). Energetic Additives holds a 50% equity interest in Energetic Systems. A private entity held the remaining 50% equity interest. Energetic Systems purchased the assets and assumed the liabilities of Slurry Explosives and Universal Tech, which operated as a joint entity (Las Vegas Review-Journal, 2002§).

Nitram Inc. was purchased by IBE Trade Corp. in January. Although it manufactured explosive-grade ammonium nitrate, Nitram was owned as a cooperative by 11 fertilizer producers in Florida, and supplied agricultural-grade ammonium nitrate primarily to citrus producers. The purchase price was not disclosed. Nitram has the capacity to produce about 272,000 metric tons per year (t/yr) of ammonium nitrate at its plant in Tampa, FL (Green Markets, 2002a).

In June, Dyno Nobel ASA and Ensign-Bickford Industries Inc. (EBI) signed a letter of intent to merge their explosives capabilities. Both Dyno Nobel and The Ensign-Bickford Co. (a subsidiary of Ensign-Bickford Industries) have a major presence in blast-initiation systems and specialty blasting products. The merger of EBI's commercial explosive initiation systems businesses, headquartered in Simsbury, CT, with Dyno Nobel was subject to the completion of a definitive agreement, due diligence by both companies, and various regulatory processes. The merger was completed in 2003 (Dyno Nobel ASA, 2002§).

Consumption

Coal mining, with 68% of total explosives consumption, remained the largest application for explosives in the United States (table 2). In 2002, U.S. coal production declined by 30.8 Mt to 992 Mt, according to preliminary data from the U.S. Department of Energy, Energy Information Administration (EIA), which was 3.0% lower than production in 2001. In a departure from what usually occurs in a year of declining U.S. coal production, production in the Western region increased somewhat, the interior region fell only slightly, while the Appalachian region decreased significantly. The 30.8 Mt drop in production in 2002 was primarily a consequence of sluggish demand by all coal-consuming sectors because of a weak economy and milder than normal weather for many parts of the country during most of the year (Freme, 2003§). Wyoming, West Virginia, and Kentucky, in descending order, led the Nation in coal production, accounting for 59% of the total. These States also were the three largest explosives-consuming States.

Quarrying and nonmetal mining, the second-largest consuming industry, accounted for 13% of total explosives sales; metal mining, 8%; construction, 8%; and miscellaneous uses, 3%. West Virginia, Kentucky, Wyoming, Indiana, Virginia, and Pennsylvania, in descending order, were the largest consuming States, with a combined total of 58% of U.S. sales (table 3).

According to U.S. Census Bureau statistics, the value of new construction fell by 1.7% based on constant 1996 dollars (U.S. Census Bureau, 2003§). Based on monthly data from the Federal Reserve Board, the seasonally adjusted industry growth rate from December 2001 to December 2002 for metal mining was -2.6%, and the growth rate for nonmetallic mineral mining and quarrying was -1.3% (Federal Reserve Board, 2003§).

Classification of Industrial Explosives and Blasting Agents.—Apparent consumption of commercial explosives used for industrial purposes in this report is defined as sales as reported to the IME. Commercial explosives imported for industrial uses were included in sales.

The principal distinction between high explosives and blasting agents is their sensitivity to initiation. High explosives are cap sensitive, whereas blasting agents are not. Black powder sales were minor and were last reported in 1971. The production

classifications used in this report are those adopted by the IME.

High Explosives.—Permissibles.—The Mine Safety and Health Administration approved grades by brand name as established by the National Institute of Occupational Safety and Health testing.

Other High Explosives.—These include all high explosives except permissibles.

Blasting Agents and Oxidizers.—These include ammonium nitrate-fuel oil (ANFO) mixtures, regardless of density; slurries, water gels, or emulsions; ANFO blends containing slurries, water gels, or emulsions; and ammonium nitrate in prilled, grained, or liquor (water solution) form. Bulk and packaged forms of these materials are contained in this category. In 2002, about 92% of the total blasting agents and oxidizers was in bulk form.

World Review

Europe.—After the explosion at an ammonium nitrate plant in Toulouse, France, in September 2001, the European Union (EU) tightened its regulations on ammonium nitrate. Storage thresholds were lowered, and safety regulations for companies that store more than 50 metric tons (t) were increased. In addition, the EU planned to request mandatory detonation testing of ammonium nitrate for fertilizer producers and importers. The testing requirement was in response to claims that importers of low-priced ammonium nitrate, mostly from Eastern Europe, were obtaining certificates from EU-produced material, then attaching these certificates to the imported products (Chemical Market Reporter, 2002; Fertilizer Week, 2002a). TotalFinaElf Group, the 80% owner of Grand Paroisse S.A., which was the plant operator, decided not to rebuild its Toulouse ammonium nitrate plant, the site of the explosion. The French police arrested the director of the operation and several employees for involuntary manslaughter for their alleged involvement in the explosion (Fertilizer Markets, 2002b).

Australia.—Australian fertilizer producers Incitec Ltd. and Pivot Ltd. announced that they would merge to form a new company, Incitec Pivot Ltd. Explosives producer Orica Ltd., which owns 76.55% of Incitec, would have a controlling share in the new company. As part of receiving Government approval for the merger, Incitec would divest its industrial chemical division, mainly involved with explosives production, to Orica for \$175 million. Incitec operated ammonia plants in Brisbane and Newcastle, a urea plant in Brisbane, and an ammonium nitrate plant in Newcastle. Pivot produced mixed fertilizers (Nitrogen & Methanol, 2002).

Colombia.—In February, the Colombian Government banned imports and production of agricultural-grade ammonium nitrate and restricted imports of calcium ammonium nitrate in an effort to stop guerrilla groups from using these materials to make explosives. Imports of calcium ammonium nitrate were not banned entirely because of the difficulty in making explosives out of that material. Ironically, the ban on ammonium nitrate imports does not cover imports of low-density ammonium nitrate, which is imported by the Government to make explosives for use by the country's coal mining industry; approximately 100,000 t/yr of low-density ammonium nitrate is imported into Colombia (Fertilizer Markets, 2002a).

Indonesia.—PT Pupak Kalimantan Timur (Kaltim) and PT Parna Raya signed a memorandum of understanding in October to build a 200,000-t/yr explosive-grade ammonium nitrate plant in Bontang, East Kalimantan. The estimated cost of the new plant was \$100 million, and startup was scheduled for 2005. Ammonia feedstock for the plant of 80,000 t/yr will be supplied by PT Kaltim Parna Industri, in which Parna Raya has a 25% interest. Demand for explosive-grade ammonium nitrate for the mining industry in Indonesia was estimated to be 165,000 t in 2002, rising to 180,000 t in 2003 (Fertilizer Week, 2002b).

Current Research and Technology

ArcTech Inc. demonstrated a method to convert obsolete explosives and propellants into fertilizer. The company uses humic acid, recovered as a byproduct during biological fermentation of coal, to decompose the hazardous materials. In a hydrolysis reaction with a proprietary reagent, the chemicals are broken up, releasing nitrogen, which bonds to the humic acid molecule. Phosphoric acid is added as a neutralizer to produce a fertilizer that contains phosphorous and potash in addition to nitrogen (Green Markets, 2002b).

Explosives-detection technology originally developed at the U.S. Department of Energy's Sandia National Laboratories is part of a new walk-through airport security tool. The SENTINEL II portal by Smiths Detection & Protection Systems—Barringer Instruments (a subsidiary of Smiths Group plc) makes it possible to noninvasively screen people for the presence of an explosive device with the same technology currently used to screen luggage and freight. The SENTINEL II walk-through portal can screen about seven people per minute for a variety of substances and can be used in facilities other than airports, such as office buildings, sports arenas, and other highly trafficked areas. Sandia developed and licensed to Barringer the sample preconcentrator used in the SENTINEL II. The preconcentrator technology efficiently traps the target particles and vapors from a large volume of air, then directs the concentrated chemical sample to Barringer's IONSCAN^{®3} detector for analysis, which enables detection of very low concentrations of explosive chemicals (Sandia National Laboratories, 2002a§).

Sandia also developed a new device that it claims is a cheaper, less dangerous way to stun kidnappers or terrorists holding hostages. The nonlethal device about the size of a small soda can creates a blinding, deafening, yet ultimately harmless explosion when thrown into a room. Unlike earlier versions that ignite from concentrated materials, the explosive source in this device fans out as an airborne powder before it ignites, making it less dangerous to hostages. The stun grenade is also reusable, thus it could be used as a training tool. The new device is made of plastic and contains only metal powder and no oxidizer. No explosion takes place within the canister. Instead of ignition within the device, the particles are forced out through 16¼-inch-diameter holes in the bottom of the

³Any use of trade, firm, or product names is for descriptive purposes only and does not imply endorsement by the U.S. Government.

structure. They form a sheet of metal dust about 5 feet in diameter before igniting by combining with oxygen present in the atmosphere. The distributed powder means that the pressure in the immediate vicinity of the exploded device is lowered to a safer level. It also means that the canister is undamaged and can be reloaded inexpensively (Sandia National Laboratories, 2002b).

A team of researchers at the U.S. Army CECOM Night Vision and Sensors Directorate in Alexandria, VA, led by a University of Mississippi professor, developed a noncontact method of detecting landmines that uses laser feedback interferometry. The researchers aim a loudspeaker at the ground and measure the vibration with a vibrometer. The instrument shines light from a series of 780-nanometer laser diodes on the vibrating ground, which modulates the backscattered light at a frequency that allows the vibrometer to calculate surface velocity. By scanning a patch of ground with a galvanometer mirror, the instrument can isolate the Doppler modulation of a landmine. The researchers are studying how gravel or grass environments affect the technology and how fast the method can go. They have made the mirrors sweep up to 10 kilometers per hour, locating mines with 100% accuracy. In addition, the team is also using synthetic aperture ground-penetrating radar, which is effective for locating deep metal mines. Using the methods together, deep or shallow mines of metal or plastic can be detected (Johnson, 2002).

Outlook

The EIA projected a 1.0% decrease in coal production in 2003 followed by a 1.3% increase in production in 2004. Production is projected to decrease in 2003 and 2004 in the Appalachian and interior regions and to increase in the Western region (U.S. Department of Energy, Energy Information Administration, 2003§). Based on the coal production projections, explosives consumption is expected to decline in 2003 and 2004. Any increase in coal production is projected to occur in the Western region, which consumes fewer explosives per ton of coal produced because of a lower overburden-to-matrix ratio. The slight gain in production in 2004 will not outweigh the lower consumption of explosives per ton of coal produced. Aberrations in weather patterns, however, could have a substantial impact on U.S. coal demand, because most coal is used for electricity production.

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TABLE 1
SALIENT STATISTICS OF INDUSTRIAL EXPLOSIVES AND BLASTING
AGENTS SOLD FOR CONSUMPTION IN THE UNITED STATES¹

(Metric tons)

Class	2001	2002
Permissibles	1,640	1,360
Other high explosives	34,300	38,100
Blasting agents and oxidizers	2,340,000	2,470,000
Total	2,380,000	2,510,000

¹Data are rounded to no more than three significant digits; may not add to totals shown.

Source: Institute of Makers of Explosives.

TABLE 2
ESTIMATED INDUSTRIAL EXPLOSIVES AND BLASTING AGENTS SOLD FOR CONSUMPTION IN THE UNITED STATES,
BY CLASS AND USE^{1, 2}

(Thousand metric tons)

Class	Coal mining	Quarrying and nonmetal mining	Metal mining	Construction work	All other purposes	Total
2001:						
Permissibles	2	(3)	(3)	(3)	--	2
Other high explosives	5	15	1	12	2	34
Blasting agents and oxidizers	1,620	303	184	168	63	2,340
Total	1,630	318	185	179	65	2,380
2002:						
Permissibles	1	(3)	(3)	(3)	--	1
Other high explosives	5	16	1	13	2	38
Blasting agents and oxidizers	1,710	319	194	176	70	2,470
Total	1,720	335	195	189	72	2,510

-- Zero.

¹Distribution of industrial explosives and blasting agents by consuming industry estimated from indices of industrial production and economies as reported by the U.S. Department of Energy, the Federal Reserve Board, the U.S. Department of Transportation, and the U.S. Census Bureau.

²Data are rounded to no more than three significant digits; may not add to totals shown.

³Less than 1/2 unit.

TABLE 3
INDUSTRIAL EXPLOSIVES AND BLASTING AGENTS SOLD FOR CONSUMPTION IN THE UNITED STATES, BY STATE AND CLASS¹

(Metric tons)

State	2001				2002			
	Fixed high explosives		Blasting agents and oxidizers	Total	Fixed high explosives		Blasting agents and oxidizers	Total
	Permissibles	Other high explosives			Permissibles	Other high explosives		
Alabama	32	486	47,800	48,400	25	650	53,000	53,700
Alaska	--	59	5,420	5,480	--	23	9,870	9,890
Arizona	34	152	113,000	113,000	40	601	79,000	79,700
Arkansas	--	180	12,400	12,600	--	377	11,100	11,500
California	1	817	72,600	73,400	1	827	52,300	53,100
Colorado	44	5,400	60,300	65,700	58	5,840	55,900	61,800
Connecticut	--	340	4,040	4,380	--	629	6,380	7,010
Delaware	--	--	76	76	--	--	--	--
Florida	--	202	15,700	15,900	--	172	17,300	17,500
Georgia	--	821	46,400	47,200	--	1,230	32,800	34,100
Hawaii	--	⁽²⁾	1,040	1,040	--	72	2,050	2,130
Idaho	3	253	11,100	11,400	5	159	11,300	11,500
Illinois	⁽²⁾	627	39,400	40,100	--	540	41,000	41,500
Indiana	--	1,030	204,000	205,000	3	1,130	220,000	221,000
Iowa	--	563	9,910	10,500	--	1,090	11,500	12,600
Kansas	--	436	5,370	5,800	--	215	7,320	7,530
Kentucky	991	2,350	314,000	317,000	780	1,990	312,000	315,000
Louisiana	--	191	1,750	1,940	--	339	2,190	2,530
Maine	--	18	49	67	--	16	1,220	1,230
Maryland ³	1	214	5,910	6,130	2	105	5,490	5,600
Massachusetts	--	546	4,410	4,950	--	553	5,200	5,750
Michigan	--	79	18,700	18,700	--	101	19,600	19,700
Minnesota	5	156	53,800	54,000	--	184	40,300	40,500
Mississippi	--	377	38	415	--	16	73	89
Missouri	4	2,930	124,000	127,000	6	1,980	60,600	62,600
Montana	14	274	17,100	17,400	17	588	26,000	26,700
Nebraska	--	73	398	471	--	387	368	755
Nevada	--	1,180	105,000	106,000	--	3,080	96,900	100,000
New Hampshire	--	889	8,250	9,140	--	1,270	11,500	12,800
New Jersey	--	211	28,900	29,100	--	221	24,400	24,600
New Mexico	5	258	25,100	25,300	--	188	10,600	10,700
New York	⁽²⁾	684	16,000	16,700	--	611	14,800	15,400
North Carolina	--	897	23,300	24,200	--	794	34,400	35,200
North Dakota	--	26	--	26	--	12	1,340	1,350
Ohio	4	483	51,600	52,100	8	1,170	62,400	63,600
Oklahoma	2	316	9,960	10,300	2	328	17,900	18,200
Oregon	--	121	1,180	1,300	--	108	5,640	5,740
Pennsylvania	64	1,860	134,000	136,000	81	1,810	117,000	119,000
Rhode Island	13	59	812	884	--	73	2,090	2,170
South Carolina	--	210	7,510	7,720	--	158	5,190	5,350
South Dakota	--	3	2,640	2,650	--	11	4,890	4,910
Tennessee	17	1,590	31,000	32,600	5	1,420	30,400	31,800
Texas	2	806	47,600	48,400	1	697	41,800	42,500
Utah	35	290	56,200	56,500	29	544	72,100	72,700
Vermont	10	147	469	626	10	172	4,230	4,410
Virginia	257	2,400	148,000	150,000	163	1,670	159,000	161,000
Washington	--	1,010	15,200	16,200	60	1,400	20,300	21,800
West Virginia	63	1,050	261,000	262,000	19	1,170	363,000	364,000
Wisconsin	--	516	13,900	14,500	1	848	12,400	13,300
Wyoming	39	703	164,000	165,000	39	528	272,000	273,000
Total	1,640	34,300	2,340,000	2,380,000	1,360	38,100	2,470,000	2,510,000

-- Zero.

¹Data are rounded to no more than three significant digits; may not add to totals shown.

²Less than 1/2 unit.

³Includes the District of Columbia.

Source: Institute of Makers of Explosives.

FIGURE 1
SALES FOR CONSUMPTION OF U.S. INDUSTRIAL EXPLOSIVES

